PROPOSAL FOR ENVIRONMENTAL RECONNAISSANCE OF THE SALTON SEA:

- **VEGETATION MAPPING**

Part of the NEPA/CEQA Process for the Salton Sea Restoration Project

Prepared for the
Salton Sea Research Management Committee

July 31, 1998

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Comments:

- Very good methodology
- Very good QAQC discussion

However, SSDP has done much of this already (thru veg. class and into aerial photo interp.).

Recommendation:

Not to fund this study, but negotiate wetlands delineation study to them.

SUMMARY

The following proposal has been prepared in response to the Salton Sea Research Management Committee (SSRMC) Request for Proposal (RFP) to conduct an environmental reconnaissance of the Salton Sea. Levine·Fricke·Recon (LFR) is ideally suited to conduct portions of the environmental reconnaissance based upon the skills and abilities of our project team (all members are experienced in undertaking these studies), our corporate resources, and our dedication to completing the job on time and within budget. LFR is strictly devoted to providing significant and defensible laboratory analytical data of the highest quality. To this end, all of the field personnel proposed on this project have extensive experience in Good Laboratory Practices (GLP), and will ensure that the utmost in field documentation, sample integrity, and quality are maintained to provide the SSRMC with meaningful data.

Through a focussed and planned approach, LFR will provide an accurate and sufficiently detailed map of the vegetation surrounding the Salton Sea and along its principal tributaries. This project will be conducted in such a manner that the information and findings of the survey will prove to be invaluable to the NEPA/CEQA processes concurrently being conducted at the Sea. LFR has all the in-house equipment and capabilities to submit its report data and findings in the required GIS-compatible format. Additionally, at no additional charge, LFR will provide copies of its reports and data on compact disk (CD).

The preparation of a Vegetation Map by Levine·Fricke·Recon will conducted through a series of processes to produce an accurate map with a quality and resolution to be beneficial in the NEPA/CEQA process. Initially, a comprehensive search for available literature on the vegetation, habitats, maps, and imagery of the Sea will be conducted. Unless an adequate source of imagery is identified, the shores of the Sea and its tributaries will be photographed to produce both full color and infrared images. These images will be available in a digital format in addition to the hard copy images. Pilot studies will be performed in the field to identify vegetation types (classifications) and recognize photographic signatures for the individual vegetation classifications. The data and experience gained from the pilot studies will be employed in the photointerpretation of the vegetation classifications. Following the photointerpretation, a Draft Vegetation Map will be produced.

The Draft Vegetation Map will be field proofed by a random sampling to verify mapped classifications. The final Vegetation Map will be produced at this time. A thorough Accuracy Assessment will be performed on the final Map. Through this process, LFR will provide a quality product the Salton Sea Authority and others may rely upon for additional analyses or investigations concerning the Salton Sea.

OBJECTIVES

The objective of the Vegetation Mapping of the shoreline of the Salton Sea is to identify sensitive habitats and areas potentially inhabiting endangered or sensitive species. The timely results of this reconnaissance level investigation will be utilized in NEPA/CEQA processes to evaluate environmental impacts potentially resulting from engineering alternatives aimed at sustaining the Salton Sea as a viable ecosystem. LFR understands there is little information available concerning a wide-scale habitat identification or vegetation mapping for the Sea, and its local surrounding area. As such, LFR has approached this project with the main objective of accurately, efficiently, and cost-effectively acquiring biological and environmental information to produce a comprehensive Vegetation Map of the area immediately surrounding the Salton Sea and its principal tributaries, which may be impacted by potential engineering alternatives being considered for the Sea. Our specific goals are:

- Map the dominant vegetation communities surrounding the Salton Sea
- Map the dominant vegetation communities along the lower portions of the principal tributaries of the Sea
- Determine the extent and distribution of riparian/wetland habitat around the Sea
- Identify habitat components of threatened, endangered, and other sensitive species
- Produce a timely, accurate, and reliable Vegetation Map using high quality science practices and adhering to established standards

NARRATIVE

Proposed Scope of Work narrative

LFR has reviewed the RFP and is proposing to work on only those sections where the SSRMC will clearly benefit because of our understanding of the project, expertise, and allocation of sufficient labor and equipment to quickly and cost-effectively complete the work. We are proposing to prepare a map and description of the dominant vegetation communities surrounding the Salton Sea and portions of the Sea's principal tributaries. The resulting information will be beneficial in identifying riparian/wetland habitat around the Sea and will provide adequate resolution to identify key habitat components of threatened, endangered, and other sensitive species.

The primary data to be utilized for the vegetation mapping is aerial photography combined with ancillary field data. The final output will be a map of the vegetation in both a hard copy and digital format. An essential part of this mapping project will be an accuracy assessment of the final database.

Background Information

The Salton Sea is the largest lake in California, with current measurements at 35 miles long and 15 miles wide, and a maximum depth of approximately 50 feet. It is approximately 278 feet below mean sea level and has a salinity of 44 parts per thousand (ocean water is 34.9 parts/thousand) (Salton Sea National Wildlife Refuge, 1998). The Sea has a surface coverage of 240,000 acres and a watershed of 8,360 square miles.

The Sea should have dried up through evaporation. It has no outlets and lies in an area with only 2.3 inches of rain a year, with temperatures reaching 120° Fahrenheit. However, drainage from the 500,000 acres of heavily watered and fertilized growing fields of the Imperial Valley has kept it alive. Agricultural wastewater carries nitrates, pesticides, toxic levels of the element selenium, and four million tons of salt leached from the soil every year (Boyle, 1996).

At least 380 species with either threatened or endangered status have been reported within the area of the Sea. According to Mr. William Radke of the U.S. Fish and Wildlife Service, "As many as 5,000 brown pelicans occasionally spend the summer on the Sea. About a third of the world's population of Yuma clapper rails depend upon its wetlands, replenished by irrigation drainwater from adjacent farmlands. The Sea provides the only inland nesting sites in the United States for gull-billed terns and provides three of only five nesting sites that exist in the Western U.S. for black skimmers" (Boyle, 1996).

The fragility of the unique ecosystem of the Sea has recently driven decision makers and land use managers to develop alternatives for the continued sustenance of the Sea.

Five qualities of the Sea are identified to be improved and sustained through the engineering alternatives. These qualities are: (1) reduction and control of Sea salinity, (2) maintain Sea levels, (3) sustain wildlife values, (4) increase recreational values, and (5) maintain agricultural drainage capabilities. Several engineering alternatives are under consideration and evaluation to determine functionality and feasibility. Currently a single preferred engineering alternative has not been identified for pursuit.

The preferred alternative could have significant impacts to the current conditions of the Sea ecosystem and environments. To address and assess these potential impacts, environmental impact statement (EIS) and environmental impact report (EIR) documents will be prepared to assure compliance with both the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). To facilitate and possibly direct the investigations within the EIR/EIS process, preliminary reconnaissance information must be collected. This information must be collected in a timely manner and be directed and conducted in a manner to provide good scientific data for analysis in the EIR/EIS process.

Our principal investigator, Dr. Richard J. Vogl, has been conducting surveys and trips on and around the shores of the Salton Sea since 1962. As an instructor, Dr. Vogl conducted annual class field trips at the Salton Sea providing lectures and lessons about the Sea's unique ecosystem. Additionally, Dr. Vogl has performed numerous vegetational surveys around the shores of the Salton Sea. This personal experience with the Sea and its environs provides a wealth of preliminary information of the Sea to aid in the classification of plant communities and the development of the methology described here. Specific projects Dr. Vogl has performed or aided in the Salton Sea region are: survey of the fresh-water (cattail) marshes (Clapper rail habitat) on the Torres Martinez Indian Reservation along the northwest Salton Sea shoreline, trained Dr. Barry Prigge in the botanical survey of Whitewater River Storm Drain and delta, including riparian and pickleweed (*Allenrolfea*) salt flats, surveyed the remaining undisturbed sugar-white sand dunes of the Coachella Valley (fringe-toed lizard habitat), conducted a creosote bush-brittlebush survey at Bat Caves, a desert grassland study at Flowering Wells near Niland, studied the effect of fire on the vegetation of Salt Creek (pupfish habitat) and adjacent Dos Palmos fan palm oasis, and performed a shoreline survey of waterfowl mortality between Oasis and Salton City (brown pelican habitat. Several times Dr. Vogl has been a guest and ecological advisor at Salton Sea State Park, Anza Borrego State Park, Wister State Wildlife Area, and Salton Sea National Refuge.

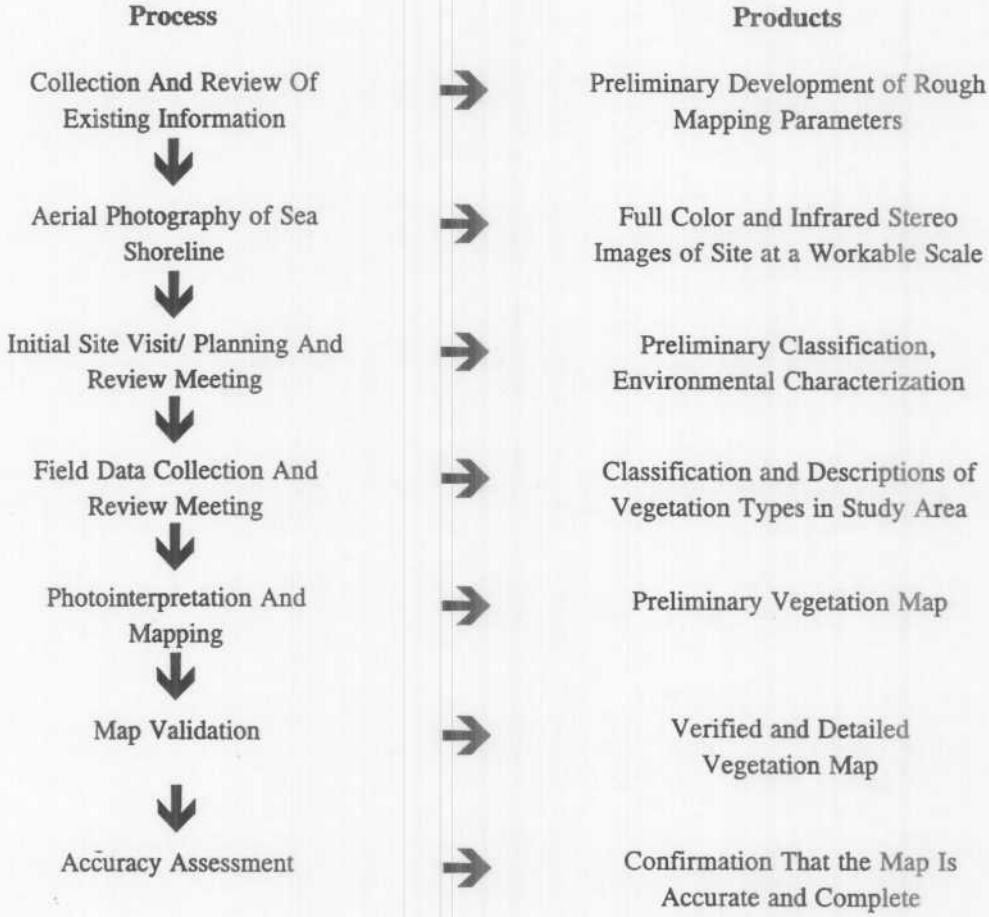
Approach

The Salton Sea is a unique ecosystem with a diverse range of habitat types. The ecotone between habitat types in some locations of the Sea are very sharp and occur within a short distance.

The proposed work revolves around a phased work schedule. Vegetation Mapping Protocols developed and utilized by the U.S.G.S. National Parks Service provide the

basis of the methodology presented herein. Modifications and additions to the NPS protocol have been incorporated into the methodology presented here to more adequately address the directives of the Salton Sea Science Subcommittee, and the unique habitat of the Salton Sea.

The following provides a summary overview of the vegetation mapping process and the product of each phase of the process. A discussion providing a more detailed account of the efforts and products of each phase of the vegetation mapping process is also provided.



Collection and Review of Existing Information

The first step is to identify and collect available literature, maps, and photographs relating to the vegetation types and communities found at the Sea. The information will be reviewed and evaluated for quality and utility to this project.

Previously conducted imagery of the environs encircling the Salton Sea will be evaluated for application to this project. Imagery that may be incorporated includes any recent photography, videography, and satellite imagery. Only imagery with a suitable

scale, accuracy, and format for facilitation in the mapping effort will be considered for analysis or inclusion in the findings.

Prior vegetation maps for all or a portion of the project Site, which are determined to exist, will be evaluated early in the data-gathering stage of the project. These previous maps will provide a preliminary classification and description of the vegetation types. Other critical information regarding the distribution of vegetation types is also available from previous maps.

Information concerning the biodiversity of the shoreline environs and wetland habitats associated with the Sea will be collected and evaluated. This information could include, but not limited to: vegetation classifications, vegetation distributions, species inventories, species range maps, and species and community distribution in relation to environmental variables. Information on vegetation classifications, lists of vegetation types, and vegetation maps facilitate the identification and development of vegetation types.

Since the distribution of the plant species within a distinct area is determined by the relationship between the vegetation and ecological processes, information on key environmental variables facilitates in characterizing the landscape and mapping the biophysical environments. Appropriate and useful data will be developed into environmental thematic layers which can be incorporated individually into a GIS database. This information is used to identify the boundaries between habitat types. This reconnaissance survey does not intend to thoroughly evaluate and present the many complex interactions between the biota and its geophysical environment.

Aerial Photography of Sea Shoreline

If appropriate and recent imagery is not available, new imagery will be acquired for the shoreline and emergent vegetation areas of the project Site.

A series of aerial photographs will be obtained of the Salton Sea shoreline and portions of the three principal tributaries entering the Sea. The photography will be taken from a near vertical vantage point on a scale of 1:12,000 to 1:24,000. The images will be in full color and stereo with approximately 60 percent overlap. Additionally, in specific areas of dense vegetation or marsh-like habitats with a high percentage of water-plant interface, color-enhanced infrared stereo photography will be performed.

The imagery will be scanned and presented in a digital format on CD-ROM disk masters. The original film will be produced as a color transparency, mounted within glass mounts, and cataloged for future reference.

Initial Site Visit and Planning Meeting

The team members will meet to discuss and assure the quality and utility of the preliminary data that has been collected. This meeting will include Dr. Richard J. Vogl, the principal investigator; Richard A. Vogl, the administrative project manager; the ecologists and photo-interpreters Jennifer Langford, Ryan Henry, and Wayne Vogler. Following the presentation of the accumulated preliminary data, parameters of the study may be refined to better address gaps or voids in the data. The preliminary data will also be formulated into thematic layers using a spatial database technology (GIS).

Following the planning meeting, the team will conduct a field trip to introduce all of the team members to the vegetation, environment, and the photographic signatures of the vegetation communities. The ecologists and photo-interpreters will begin field recognition of the vegetation, biophysical environments, landforms, and the relationship of these features to the aerial photography.

Field Data Collection

Field data collection will be completed to classify, and fully describe all vegetation types within the project study area.

Polygons of different vegetation types will be delineated through the interpretation of aerial photography across the pilot study areas. Standard photointerpretation techniques will be employed; these techniques are dependent on the identification of homogenous patches of color, texture, and pattern. Within each homogeneous area, pilot study plot boundaries will be marked and the general physiognomy of the community will be recorded.

The field work will be stratified to sample all vegetation types on all biophysical classes across the pilot area. The number of samples per class will be determined by total coverage and number of polygons of each type, and will be flexible to account for the degree of biological and environmental variability. It is anticipated that in most locations only three to five samples will be required.

The vegetation will be visually divided into strata and the average height and percent cover of each stratum will be recorded. Within each stratum, all species will be identified, and the relative abundance of each described by a visual percent cover estimate.

In addition to the species information, a number of environmental variable will be recorded for each plot to characterize the precise conditions under which the sampled vegetation occurs. This data will include measured abiotic variable, additional biological data, historical/disturbance data, and landscape relationships.

Field ecologists will collect standardized plot data which will be recorded on Field Forms (see attached example) on approximately ten samples of all vegetation classes across the pilot area. Information provided on the Field Form includes:

1. Elevation of the plot
2. Topographic position, and landform: The position of the community/sample within the landscape will be assigned to one or more of a standardized list of categories
3. Slope: The slope of the area, in degrees, will be measured using a clinometer
4. Slope aspect: The aspect will be recorded from a compass correcting for the magnetic declination
5. Surficial geology: The significant geological features will be described using a geological map of the area, and, when possible, further notes on the composition of exposed outcrops will be noted at the site
6. Hydrologic regime for wetlands
7. Basic soil profile description
8. Soil texture
9. Soil drainage: Soil drainage will be estimated in the field using topographic position, soil texture, and apparent moisture regime

Each sample plot will be labeled with a unique name to identify the polygon and plot sampled. The location will be marked on the base topographic map and field copies of aerial imagery. The location will also be precisely recorded for latitude and longitude recorded using Global Positioning System instrumentation. The geographical coordinates of the plot area will be entered into the spatial GIS database for the project.

Review Meeting

Following field activities, a meeting will be conducted among the team members to synthesize and interpret the data collected from the pilot study areas. This synthesized data will be used to identify key photographic signatures for the plant communities encountered during the initial field investigation. The list of classification units will be refined and the descriptions of the vegetation types and key environmental indicators will be developed.

All team members will make an effort to identify any gaps in the pilot study in terms of biophysical environments, vegetation types, and additional features that should be mapped. A list of inventory units will be developed and utilized in the methodology throughout the remainder of the project.

Photointerpretation and Mapping

A team of ecologists and photointerpreters will review the aerial imagery of the Salton Sea shoreline and associated wetland habitats to identify vegetation communities. The methodology and experience from the pilot study will be used in the interpretation of the aerial photographs. Following the photointerpretation of the pilot study areas, the vegetation classification, description, environmental position, and photointerpretation techniques will be applied to the remainder of the project study area.

The photographic imagery will be interpreted for patterns of tone, texture, color, and contrast to identify homogeneous patches of vegetation. These patterns will be assigned to a preliminary vegetation type from published vegetation classification standards based on the preliminary review of vegetation types.

The vegetation keys and descriptions will be constantly updated with the addition of new information on known types and the documentation of new types. Photo signatures that are unidentifiable will be marked as unknown and will be further investigated through the Map Validation process.

The distinct vegetation classifications will be demarcated upon the aerial imagery during initial photointerpretation. Subsequent to the demarcation of a vegetation type, the polygon will be digitized for inclusion as a thematic layer into the Vegetation Mapping GIS Database.

Map Validation

Following the draft mapping of the vegetation types and wetland habitats encircling the Salton Sea shoreline, an assessment of class accuracy will be performed, or ground truthing, of the aerial imagery interpretation. The vegetation class accuracy will be determined through the stratification of sample points by class throughout the park. These validation points will be spread over the full range of the geographical and environmental distribution for each vegetation class.

Any areas identified as unclassified, or problem areas during imagery interpretation, will be visited to field determine the appropriate and correct vegetation classification.

Field reconnaissance of sub-habitats or microecotones which may provide habitat for special status species will be identified and incorporated into the Final Vegetation Map.

Spatial Database Technology

The Final Vegetation Map will be delivered in a GIS-compatible format. The Federal Geographic Data Committee metadata standards will be followed in the preparation of all deliverable maps and associated databases. Physical point locations will be accurately positioned using GPS technology.

Quality Assurance and Quality Control

Accuracy Assessment

In terms of positional accuracy, the data will meet National Map Accuracy Standards (NMAS). An inherent problem with accuracy assessment for vegetation mapping is the interpretive nature of vegetation mapping. Thematic interpretations of biological and geophysical characteristics can be varied. Procedures to ensure accuracy must be scientifically sound and yet practical to implement. Any method to ensure accuracy should capture all the components of uncertainty associated with vegetation mapping. The requirements of accuracy for each vegetation class mapped will be 80 percent. Minimally, accuracy assessment procedures should be able to determine, with sufficient precision, whether the vegetation map meets these requirements.

Methodology for assuring this level of accuracy will be presented in a Quality Assurance Project Plan will be presented to the Science Subcommittee for review and evaluation prior to the initiation of project work. To ensure valid and accurate data are presented, Accuracy Assessment Procedures for Vegetation Mapping developed and utilized by the U.S.G.S. National Park Service (NPS) during their Vegetation Mapping Program for over 150 National Parks.

The Accuracy Assessment Procedures for Vegetation Mapping developed by the NPS can be summarized as follows:

1. Accuracy will be assessed at the conclusion of the mapping process and will be independent of the mapping process.
2. The most desirable, though not exclusive, source of higher accuracy against which the classified data will be compared is field checking.
3. Both thematic and positional accuracy will be assessed.
4. The core thematic accuracy assessment procedures are defined as follows:
    - The number of sample sites per class will vary from five to thirty, dependent on the frequency and abundance of the class.
    - Multiple sites per polygon will be allowed. The method by which sample sites will be allocated to polygons will be weighted to give preference to larger polygons.
    - Sample sites will be randomly allocated within a class, but they will be positioned away from the polygon boundaries by an amount equivalent to the positional error in the data and the error associated with locating the sample site in the field.
    - Sample sites will be located by means of randomly generated point coordinates. For each point location, an area equivalent to or larger that the MMU will be observed. Sample sites will be located in the field by GPS surveying methods.
    - All information, including the name of the investigator(s), the date and time of the visit, and other pertinent information will be recorded on a field assessment form.

5. Positional accuracy will be limited to estimating how well the data can be tied to its control.
6. Errors will be analyzed through an appropriate statistical analysis for both thematic and positional values.
7. Accuracy procedures will be evaluated to assure specified accuracy requirements can be met. Appropriate changes or modifications of the procedure will be implemented if deemed necessary. Changes and modifications to the QAPP will be discussed with the Science Subcommittee prior to their implementation.

Reporting

LFR is prepared to forward its preliminary findings and laboratory data to the SSRMC once the data have been verified and prior to the completion of the Final Vegetation Map. Our report will include the following items, at a minimum:

- A description of the vegetation classifications presented on the Vegetation Map.
- A description of the sampling methods used and an explanation for any instances where sampling methods were modified from the standard protocols.
- Results of the field sampling. Results will include a discussion of the Pilot Plot areas, a discussion of the findings from each plot area, and graphics depicting a representation of the plot areas.
- A description of the Quality Assurance Project Plan (QAPP) and Accuracy Assessment. Data will be evaluated against the plans to ensure that data presented are accurate, statistically significant, and defensible. Any instances where data do not meet the objectives of the plans will also be noted.
- The results and findings of the Accuracy Assessment analysis. The processes of and the statistical findings of the Accuracy Assessment will be presented.
- Conclusions and findings regarding the study. Recommendations, as appropriate, may be provided.
- Appropriate figures, tables, and appendices with field data sheets, sampling protocols, analytical protocols, statistical protocols, etc.
- All data will be submitted in a GIS-compatible format according to the metadata standards set forth by the Federal Geographic Data Committee.

LFR will prepare a draft document for review by the SSRMC. Upon the concurrence of the SSRMC, LFR will incorporate any required changes and submit its report as final.

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IDENTIFIERS/LOCATORS

Polygon Code_____ Plot Code_____

Provisional Community Name_____

Location _____

_____

Latitude___ ___ ___ ___ ___ ___ N Longitude___ ___ ___ ___ ___ ___ ___ W GPS Error_____

Survey Date_____ Surveyors_____

Directions to Plot

Plot length_____ Plot width_____ Plot Photos (y/n) _____ Plot Permanent (y/n) _____

Plot representativeness

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect_____

Topographic Position

Landform

Surficial Geology

Hydrologic regime

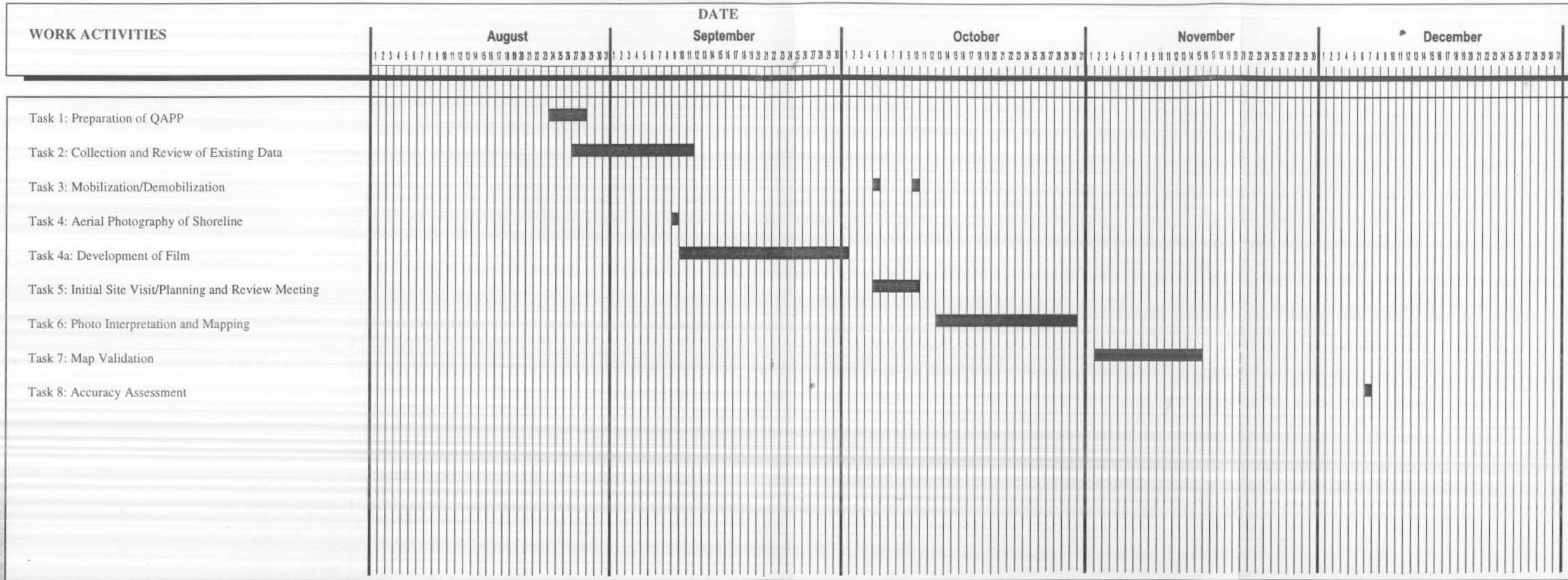
Tidal	Non-tidal	Salinity/Halinity modifiers
___Irregularly Exposed	___Permanently Flooded	___Saltwater
___Regularly Flooded	___Semipermanently Flooded	___Brackish
___Irregularly Flooded	___Seasonally/Temporarily Flooded ___Saturated	___Freshwater
	___Seasonally flooded/saturated	
___Unknown	___Intermittently flooded	

Soil Taxon/Description

Soil Texture
___ sand ___ sandy loam ___ loam ___ silt loam
___ clay loam ___ clay ___ peat ___ muck

Soil Drainage
___Rapidly drained ___Well drained ___Moderately well drained
___Somewhat poorly drained ___Poorly drained
___Very poorly drained

MILESTONES AND PRODUCTS



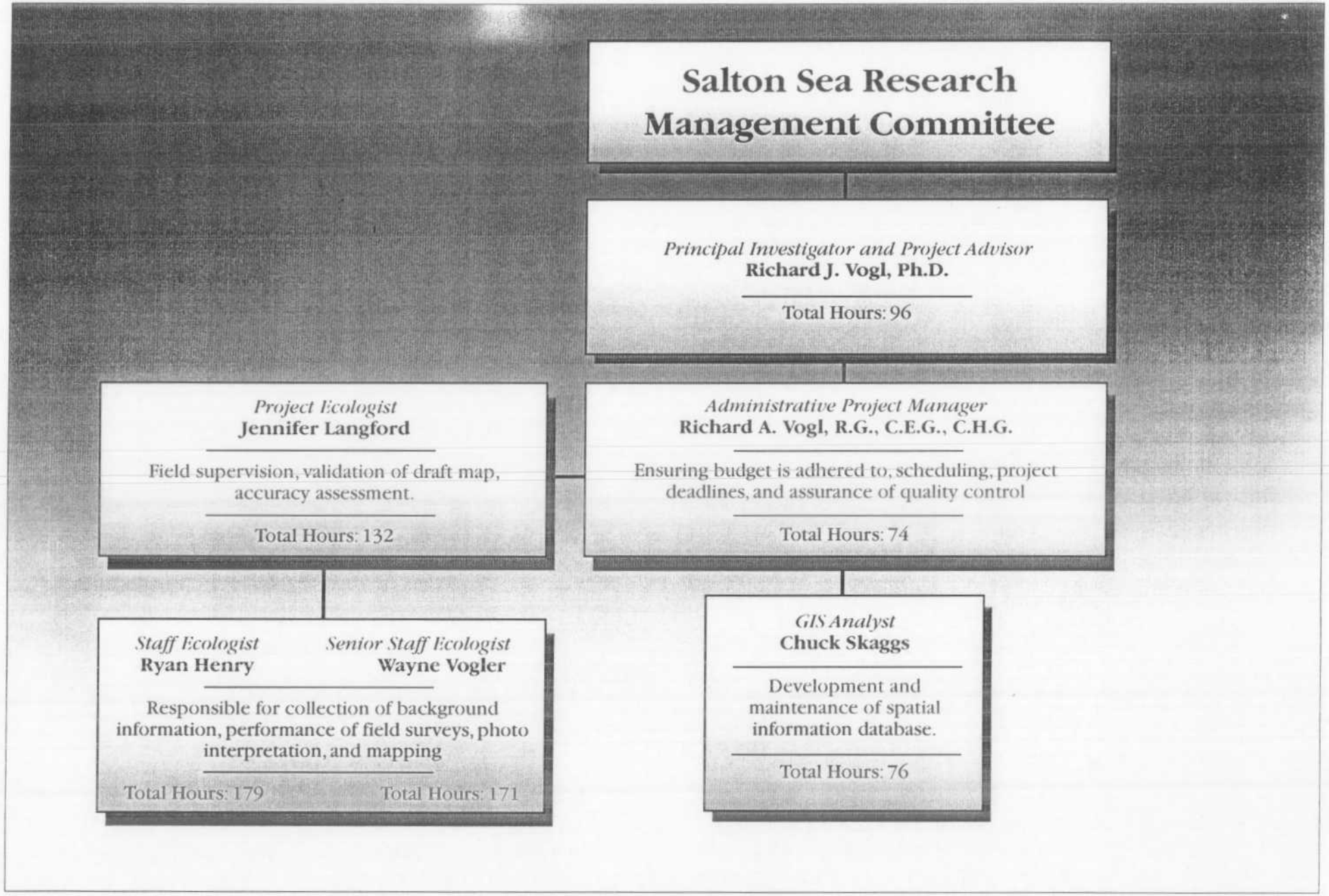
Salton Sea

Vegetation and Mapping Milestones and Products

Levine·Fricke·Recon Table 2

Project No. p0676 -98

STAFFING



Vegetation Map Survey - Staffing

RICHARD J. VOGL

Professor Emeritus of Biology
Department of Biology
California State University, Los Angeles
Retired, 1994

Salton Sea ecology studies
ecological restoration
botany
marsh and wetlands ecology

EDUCATION

Marquette University, Milwaukee, Wis.: Ph.D., 1961

Marquette University, Milwaukee, Wis.: M.S., 1955

Marquette University, Milwaukee, Wis.: B.S., 1953

REPRESENTATIVE EXPERIENCE

- Consultant regarding ecological problems of fire, wetlands, deserts, chaparral, grasslands, conifer forest, and urban development in California and other states.
- Taught a short course on wetlands ecology for Los Angeles Office of U.S. Army Corps of Engineers.
- Evaluated the City of Santa Barbara's flood control system for Santa Barbara County.
- Conducted Environmental Impact Study of Ring Brothers wetland parcel in Huntington Beach for Ultra Systems, Inc.
- Served on California Department of Fish and Game Advisory Committees for the restoration of Bolsa Chica Salt Marsh and Upper Newport Bay.
- Advisor to Caltrans Environmental Selection on coastal wetlands from 1976 to present.
- Evaluated Environmental Impact Study on Summa Corporation's Ballona Wetlands for Envicom Inc.
- Ecological consultant for Mills Land and Water Co. parcels in Huntington Beach, California, and a major contributor to a report, "An ecological study of certain former salt marsh properties in the city of Huntington Beach."
- Served as the ecological consultant for Mills Land & Water Co. from 1980 to present, consulting on wetland matters, including a reverse condemnation suit of Mills vs. Caltrans.
- Presented paper of "Productivity and Plant Adaptation" at Coastal Wetlands of California Symposium, Fullerton College.
- Served as an expert witness for U.S. Environmental Protection Agency in suit of Ann Gosuch vs. Halico Corp. regarding Ormond Beach Salt Marsh.

1978 to 1982. U.S. Department of the Interior. National Park Service Managing Natural Resources Courses.

1977 to 1982. Journal of the California Botanical Society. Member of the Board of Directors.

1970 to 1977. California State University, Los Angeles, Department of Biology. Associate Chairman.

1972 to 1975. Journal of the Ecological Society of America. Botanical Editor.

1970 to 1975. Tall Timbers Research Station, Tallahassee, Florida. Member of Board of Directors.

1969. Nature Conservancy research expedition to the northeast outer slopes of Maui, Hawaii. Team leader.

1966. Nature Conservancy, Southern California Chapter. President.

Teaching Experience

- Visiting Professor of Botany/Ecology, University of Montana Biology Station
- Visiting Professor of Botany, University of Hawaii
- Research Fellowship, Tall Timbers Research Station, Tallahassee, Florida
- Visiting Professor of Botany, Southern Methodist University Field Station
- Professor of Biology, California State University, Los Angeles (CSULA)

PARTIAL LIST OF PUBLICATIONS

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RICHARD A. VOGL, R.G., C.H.G., C.E.G., R.E.A.

Senior Associate Hydrogeologist

project management
hazardous waste site assessment
aquifer characterization
soil and groundwater remediation
biological survey
wetland evaluation and determination

Mr. Vogl has performed and managed numerous wetlands projects, site investigations, environmental assessments, aquifer characterizations, and remedial actions. His strong field background and project management skills in environmental assessments and remediation have provided the necessary abilities to manage a wide variety of environmental projects.

Mr. Vogl has managed and worked on numerous large-scale groundwater restoration projects at petroleum refining and storage facilities within Southern California. This work involved permitting, agency liaison, bid preparation, aquifer characterization, system design, coordinating work with contractors, site assessment, and remediation of soil and groundwater affected by petroleum hydrocarbons. In addition, Mr. Vogl has managed an investigative group of geologists to assess and remediate hydrocarbon-affected soil and groundwater for major petroleum marketing corporations. This work included permitting, regulatory liaison, scheduling and coordinating of field and office work, and overall quality assurance and control of the assessment, remediation, and reporting phases of the project.

EDUCATION

University of California Irvine Extension: Certificate in Environmental Site Assessment and Remediation, 1993

California State University, Los Angeles: M.S. Geology, 1990

California State University, Los Angeles: B.S. Geology, 1987

Cypress Junior College: A.S., 1984

REPRESENTATIVE EXPERIENCE

- Developed, managed, and conducted soil and groundwater assessments and remediations in Santa Barbara, Los Angeles, and Riverside counties in southern California.
- Managed and conducted a detailed soil-gas survey at a major petroleum refinery located.
- Managed and conducted monitoring well baildown tests to estimate the true volume of free phase jet fuel that was present on the water table at a petroleum storage facility.

- Conducted a biological evaluation of a Caltrans interchange in the city of San Gabriel.
- Conducted a biological evaluation of riparian habitat for a street extension project at Whittier Narrows in Rosemead.
- Conducted a complete biological survey/quantitative analysis of 60- and 80-acre salt marsh wetlands with an emphasis on endangered species in Huntington Beach.
- Conducted an oasis evaluation for the California Natural Areas Preserve system of the Pushawalla Oasis in Thousand Palms.

PUBLICATION

Vogl, R.A. 1990. Measurement of true hydrocarbon thickness using borehole data versus monitoring wells. Masters Thesis submitted to the Graduate College, California State University Los Angeles, Los Angeles, California.

REGISTRATIONS

Certified Engineering Geologist: California, No. 2036

Certified Hydrogeologist: California, No. HG-47

Registered Geologist: California, No. 5526

Registered Geologist: Arizona, No. 26396

Registered Geologist: Oregon, No. G1456

Registered Environmental Assessor: California, No. 02570

AFFILIATIONS

National Ground Water Association

PROFESSIONAL HISTORY

Levine·Fricke·Recon (formerly Levine·Fricke, Inc.), Senior Hydrogeologist, 1991-date

Riedel Environmental Services, Project Hydrogeologist, 1990-1991

Engineering Enterprises, Inc., Field, Staff, Project Hydrogeologist, 1987-1990

WAYNE VOGLER

Staff Scientist

ecological restoration
environmental site assessments

Mr. Vogler is responsible for conducting Phase I Environmental Site Assessments and evaluating potential property contamination from historical or present site operations, local off-site property operations, and reported regional releases involving contaminant migration. He is adept at researching material on the site and reporting that information clearly and concisely for the client. He is also proficient at researching government records, reviewing environmental databases, and interpreting historical aerial photographs to achieve the highest level of thoroughness for the client. His detailed performance has often lead to solutions to problems encountered.

Mr. Vogler has full AHERA certification, including a California Occupational Safety and Health Administration (Cal-OSHA) as a site surveillance technician, as well as advanced certificates in environmental and ecological studies.

EDUCATION

University of California, Irvine: B.S. Ecology and Environmental Science, 1994

REPRESENTATIVE EXPERIENCE

- Conducted and reported over 70 site assessments in California, Colorado, Hawaii, Illinois, Nevada, and New Mexico.
- Obtained and reviewed historic records to assess past site conditions and their effect on current conditions.
- Conducted an independent research project on animal habitat after a fire.

CERTIFICATIONS

Cal-OSHA Site Surveillance Technician

AHERA Inspector

AFFILIATION

Association of Groundwater Scientists & Engineers

RYAN HENRY

Staff I Ecologist

ecological restoration
exposure assessment

Mr. Henry has diverse professional experience as an environmental consultant. In addition, his background studies in biological sciences and social ecology University of California, Irvine, have given him a broad knowledge in biological and environmental factors.

EDUCATION

University of California, Irvine: B.S. Applied Ecology, 1998.

REPRESENTATIVE EXPERIENCE

- EPA Proposal, Sorting Code 97-NCERQA: Integrated Retention Ponding System and Constructed Wetlands: An Option for the Aliso Creek Watershed, Orange County, California. 6/97.

- Investigated the metabolic capabilities of various species of bacteria, natural population densities, and the presence of chemicals in the San Diego Creek-Estuary-Pacific Ocean ecosystem. June 1997. Oadele Ogunseitan, Program Director.

- Implemented a program at the University of California, Irvine's Social Ecology I Laboratory, to assess and monitor Class 100 and Class 1000 cleanroom contamination.

- Participated in the U.S.-Mexico symposium at the El Colegio de la Frontera Norte, Tijuana, Baja California on Current Research and Clinical Activity in Source Characterization, Exposure Assessment, and Lead Abatement in Tijuana, B.C. August 2, 1996.

CERTIFICATIONS

OSHA 40 Hour Hazardous Waste (HAZWOPER)

PROFESSIONAL HISTORY

University of California, Irvine—Exposure Assessment and Lead Abatement Research Volunteer. April, 1996 to September, 1996.

JENNIFER A. LANGFORD

Project Ecologist, Wetland Scientist

restoration of riparian habitats
biological site assessments
report preparation
project management

Ms. Langford has over ten years of diversified experience in environmental science. She has prepared mitigation plans, conducted restoration projects, and completed biological studies for inclusion in Environmental Impact Reports and Statements. She has prepared reports describing and inventorying biological resources for a variety of habitats, discussed the potential impacts of projects on native habitats, and developed measures to mitigate for identified impacts. As an employee of a large planning and engineering firm, Ms. Langford performed a major role in processing Environmental Assessments, Environmental Impact Reports, Environmental Impact Statements, Negative Declarations, Environmental Notices, and other CEQA and NEPA documentation.

Ms. Langford is well versed on riparian systems and the restoration of riparian habitats and has logged numerous field hours identifying and classifying species and habitats. As a member of the Nipomo-Guadalupe Dunes Forum for the Nature Conservancy, she acts as a technical advisor concerning riparian restoration for the Central Coast Salmon Enhancement. She has also presented to the California Chapter of the Society of Ecological Restoration on oak woodland restoration and presented a poster on mine reclamation.

EDUCATION

California Polytechnic State University. San Luis Obispo: M.S. Biology, 1997

California Polytechnic State University. San Luis Obispo: B.S. Environmental and Systematic Biology, 1984

REPRESENTATIVE EXPERIENCE

- Prepared a native vegetation and enhancement plan for an Audubon International Signature Golf course. The project involved the eradication of veldt grass, an invasive exotic grass, and revegetation with native coastal scrub/maritime chaparral species.
- Project Manager for an annual Land Condition Trend Analysis Vegetation Survey of Camp Roberts and Camp San Luis Obispo.
- Project Manager for a Riparian Inventory and Management Plan for the Barka Slough and San Antonio Creek, Vandenberg Air Force Base.

CHARLES R. SKAGGS

GIS Analyst

geographic information systems
database design and management
system administrator for ARC/INFO

Mr. Skaggs is knowledgeable with many facets of environmental science, including Physical and Tectonic Geomorphology; Remote Sensing and Airphoto Interpretation; Surveying and Mapping; and Hydrology. He is skilled in developing and planning GIS and applications, including Land Records, Hazardous Material, and County Assessor databases. He is also experienced with teaching at the academic and professional levels. He is conversant in Spanish and has conducted private consulting in CADD and GIS.

Mr. Skaggs is experienced with VMS, UNIX, NT, and DOS operating systems. He has 10 years of experience with ARC/INFO. He is proficient with ARCVIEW, COGO, AML, TIN, ARCEDIT, ARCPLOT, LIBRARIAN, and data conversions. He is also familiar with ORACLE and SQL. He is experienced with other PC based GIS packages such as MAPINFO, ATLAS*GIS, and AUTOCAD.

EDUCATION

University of Louisville, Kentucky: B.S. Physical Geography (with Honors)

California State University, Fullerton, California: Graduate course work in GIS

REPRESENTATIVE EXPERIENCE

- GIS Analyst for the Southern California Comprehensive Water Reclamation and Reuse Study, a coöperative effort by Southern California water agencies and the Bureau of Reclamation. The project analyses data and develops ranges for alternatives and cost options to be considered for water reclamation and reuse in Southern California. Project responsibilities include database creation and design, application development and implementation, modeling, and publication of data and results on the Internet.
- GIS analyst for Marine Corps Air Station (MCAS) El Toro. Mr. Skaggs' responsibilities included converting and standardizing data and organizing databases, linking well and soil samples sites in GIS to EDMS-I containing chemical analysis data, and generating presentation and report graphics and tabular reports. GIS is used on the Operable Unit 1 remedial investigation/feasibility study, primarily as a data management tool. It is used to covert, standardize, and maintain spatial data acquired from a variety of sources. In

AFFILIATIONS

Honorable Order of Kentucky Colonels

Association of American Geographers

California Geographic Information Association

PROFESSIONAL HISTORY

Levine·Fricke·Recon Inc., GIS Analyst, 1997-present

CH2M Hill, GIS Analyst, 1995-1997

Association of Monterey Bay Area Governments, GIS Analyst, 1994

City of Irvine, GIS Engineering and Mapping Technician, 1989-1994

Department of Geography: California State University Fullerton, Graduate Assistant, 1989-1990

United States Geological Survey, WRD, GIS Technician, 1988-1989

Kentucky Department of Natural Resources, NDREP, GIS Cartographic Intern, 1988

EXPERIENCE

TABLE 2: EXPERIENCE

Project Name	Scope of Work	Project Reference
County Sanitation Districts of Los Angeles County, Puente Hills Landfill	Hydrogeologic investigation, including collecting oriented cores and conducting 21 packer tests. Installation of 7 piezometers with slug and pumping aquifer tests.	Mr. John Hower *County Sanitation Districts of Los Angeles County* Phone : (562) 699-7411
Siemens North Indian Bend Wash	Development of a comprehensive water management plan.	Mr. John Wyss *Siemens Components Inc.* Phone : (408) 725-3505
Akzo Brea	Site investigation involving 29 combined liquid and vapor extraction wells and 6 dual-zone vapor extraction wells.	Mr. Doug Butler *Akzo Nobel coatings* Phone : (502) 375-5467
Akzo Torrance	Soil / groundwater investigation involving 40 vapor extraction wells and 10 groundwater monitoring wells.	Mr. Doug Butler *Akzo Nobel coatings* Phone : (502) 375-5467
City of La Mirada East	Soil / groundwater investigation and remediation.	Mr. John Di Mario *City of La Mirada* Phone : (714) 943-0131
City of La Mirada West	Hydrogeologic evaluation, installation of monitoring wells, and groundwater assessment.	Mr. John Di Mario *City of La Mirada* Phone : (714) 943-0131
Greeff Van Luit	Groundwater assessment and remediation, including the installation of 4 extraction wells and 25 monitoring wells.	Mr. Bruce Edelson Phone : (310) 544-7007
Color Spot	Soil and groundwater assessment and remediation program monitoring.	Mr. Glenn Brooks *Pacificorp Financial Services* Phone : (503) 797-6301
Akzo Ardrox	Subsurface soil and groundwater investigation and remediation.	Mr. Doug Butler *Akzo Nobel coatings* Phone : (502) 375-5467

Company	Job Name	Contact
Bagahi Engineering	Bagahi: Temecula Plaza Site City : Temecula - Start Date: 12-Jun-94 / End Date: 24-Jun-94	Ken Bagahi Phone : (949) 252-8292
Bagahi Engineering	Bagahi: Temecula Plaza Site City : Temecula - Start Date: 09-Jun-95 / End Date: 09-Jul-95	Ken Bagahi Phone : (949) 252-8292
Santa Fe Pacific Pipelines, Inc.	SFPP: Coachella Ecological Study Site City : Coachella - Start Date: 12-Sep-94 / End Date: 31-Oct-94	K.S. Ibaraki Phone : (714) 560-4400
Port of San Francisco	Port of San Francisco: Cape Mohican Damage Assessment Site City : San Francisco - Start Date: 05-Nov-96 / End Date: 05-Nov-97	Roberta Jones Phone : (415) 274-0562
CA Reg. Water Quality Control Bd.	SFRWQCB: Se Expert Witness Start Date: 15-Mar-94 / End Date: 31-Aug-94	Kim Taylor Phone : (510) 286-1255
CA Reg. Water Quality Control Bd.	SFRWQCB: Se Technology Review Start Date: 04-Nov-94 / End Date: 31-Dec-97	Kim Taylor Phone : (510) 286-1255
Etec	Etec: Acid Waste Neutralization System Site City : Hayward - Start Date: 10-Nov-97 / End Date: 15-Jul-98	
Levine-Fricke-Recon	LF Restoration: Montezuma Wetlands Site City : Collinsville - Date: 91 /92	Jim Levine Phone : (510) 652 4500
Unocal	Unocal: Assessment for Remediation Site City : Guadalupe - Start Date: 07-Feb-98 / End Date: 01-Jul-99	
Unocal	Unocal: Guadalupe Emergency Remedial Actions, 1998 Site City : Guadalupe - Start Date: 25-Feb-98 / End Date: 01-Jul-98	
Unocal	Unocal: Guadalupe Oil Field Site City : Guadalupe - Start Date : 16-May-98 / End Date : 01-Dec-99	

FACILITIES

Levine·Fricke·Recon (LFR) was established in 1969 to address environmental problems with clear, concise, and effective remedial actions. We have since developed into a full-service environmental consulting firm, with offices and projects worldwide. In 1995, Levine·Fricke merged with Recon Environmental Corporation, a subsidiary of HW Engineering Group, a privately owned French firm. HW Engineering Group has offices in France, Taiwan, the Czech Republic, Brazil, and Tunisia. We are now known as Levine·Fricke·Recon Inc. (LFR).

LFR's approach to solving environmental problems is unique. First, we are solution-oriented. We strive to identify and understand environmental issues as quickly and efficiently as possible, so that effective solutions can be readily enacted. Second, we maintain effective interdisciplinary project operations. Project managers coordinate teams of professionals with diverse experience in a broad range of specialized areas of science and engineering. This coordinated effort provides cross-checking of project work to achieve effective, broad-based solutions. Last, we are a dynamic company that continues to adapt to changing demands in the environmental marketplace. We take the long view in our business planning, with an emphasis on building for tomorrow and ensuring that our clients' needs will continue to be met in the future. LFR is equipped with the following relevant facilities and equipment for producing a quality Vegetation Map:

Field Supplies: LFR has a fleet of Ford Pickup trucks and four-wheel drive vehicles available for accessing all of the study areas. Additionally, watercraft available to provide access to areas of the Sea include a 15-foot Klamath 10-hp outboard motor, 21-foot Bayliner Trophy with walk-around cutty and 10-hp outboard motor, and a two-person canoe. Plot locations will be geographically located using a differential GPS unit or a hand-held GPS unit.

Aerial Photography: LFR has a relationship with Geo-Technical Imagery who would conduct and provide the aerial imagery under LFR's oversight. The camera system is a motor driven Bronica ETRS 70 mm 2.25 inch system. The imagery will be scanned into digital format using a transparency scanner developed for this purpose. To provide aerial access, an MD 500 helicopter with a 4-passenger capacity will be used.

GIS Database Support: LFR has in-house personnel and equipment for developing and supporting GIS services. Our local Irvine office has three workstations staffed with full-time operators dedicated to performing GIS mapping and other services. Additionally, we have full size color plotters and printers for producing professional and usable products.

BUDGET

The following provides a summary of the costs for performing the Vegetation Mapping project as outlined in this proposal. A detailed schedule of costs is provided on the following page. The sum of discounts offered to the Resource Management Committee is provided below.

LFR Labor	$64,747.00
LFR Equipment Rental	$1,475.00
Expenses (including Administrative Fee)	$2,990.00
Subcontractor Expenses (including Administrative Fee)	$12,320.00
Subtotal	$81,532.00
Sum of all **authorized discounts** and **reductions**	($3,721.20)
Subtotal	$77,810.80
Communications Fee (2.4%)	$1,867.47
Total	**$79,678.00**

Task Cost Projections

Client:Salton Sea Research Management Committee
Vegetation Mapping
Project #: P0676-981

Task 1:	Preparation of QAPP	**Task 6:**	Photointerpretation and Mapping
Task 2:	Collection and Review of Existing Information	**Task 7:**	Map Validation
Task 3:	Mobilization/Demobilization	**Task 8:**	Accuracy Assessment
Task 4:	Aerial Photography of Shoreline		
Task 5:	Initial Site Visit/ Planning and Review Meeting		

HOURLY RATE	PERSONNEL		TOTALS HOURS	TASK NUMBERS 1	2	3	4	5	6	7	8
$60.00	Principal Investigator (Richard J. Vogl)		96.00	2.00	4.00	8.00	0.00	10.00	32.00	16.00	24.00
$145.00	Administrative Project Manager (Richard A. Vogl)		74.00	0.00	0.00	8.00	8.00	10.00	0.00	16.00	32.00
$108.00	Project Ecologist (Jennifer Langford)		132.00	2.00	8.00	26.00	0.00	40.00	0.00	32.00	24.00
$92.00	Senior Staff Ecologist (Wayne Vogler)		171.00	8.00	25.00	12.00	8.00	40.00	70.00	8.00	0.00
$60.00	Staff I Ecologist (Ryan Henry)		179.00	24.00	25.00	12.00	0.00	40.00	70.00	8.00	0.00
$78.00	Engr. Designer/CADD Oper./Illust. IV		8.00	2.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00
$81.00	GIS Analyst/Specialist III (Charles Skaggs)		76.00	0.00	10.00	0.00	0.00	10.00	32.00	8.00	16.00
$77.00	Technical Editor III		7.00	3.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
$42.00	Reproduction Assistant		5.00	2.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
	Total Hours:		**748.00**	**43.00**	**72.00**	**66.00**	**16.00**	**150.00**	**214.00**	**91.00**	**96.00**
	Personnel Cost		$64,747.00	2,983.00	5,714.00	6,272.00	1,896.00	13,260.00	15,928.00	8,726.00	9,968.00
	(Authorized Personnel Discount)	5.0%	($3,237.35)	(149.15)	(285.70)	(313.60)	(94.80)	(663.00)	(796.40)	(436.30)	(498.40)
	Personnel Total:		$61,509.65	$2,833.85	$5,428.30	$5,958.40	$1,801.20	$12,597.00	$15,131.60	$8,289.70	$9,469.60
	EXPENSES / LFR EQUIP. RENTAL										
	Travel Expenses		$2,200.00	0.00	0.00	0.00	0.00	1,700.00	0.00	500.00	0.00
	Cellular Phone Charges		$400.00	0.00	50.00	0.00	50.00	200.00	0.00	100.00	0.00
	Overnight Charges		$70.00	15.00	0.00	0.00	0.00	0.00	0.00	40.00	15.00
	LF Equip. Rental (NO ADMIN. FEE CHARGED)		$1,475.00	0.00	250.00	0.00	125.00	550.00	0.00	550.00	0.00
	(Authorized LFR Equipment Discount)	5.0%	($73.75)	0.00	(12.50)	0.00	(6.25)	(27.50)	0.00	(27.50)	0.00
	Administrative Fee	12.0%	$320.40	1.80	6.00	0.00	6.00	228.00	0.00	76.80	1.80
	(Authorized Reduction in Admin. Fee)	3.0%	($80.10)	(0.45)	(1.50)	0.00	(1.50)	(57.00)	0.00	(19.20)	(0.45)
	Expenses/LFR Equip. Rental Total:		**$4,311.55**	**$16.35**	**$292.00**	**$0.00**	**$173.25**	**$2,593.50**	**$0.00**	**$1,220.10**	**$16.35**
	SUBCONTRACTORS										
	GTI Photo-graphics Bureau		$8,250.00	0.00	0.00	0.00	8,250.00	0.00	0.00	0.00	0.00
	Helicopter Rental		$2,750.00	0.00	0.00	0.00	2,750.00	0.00	0.00	0.00	0.00
	Administrative Fee	12.0%	$1,320.00	0.00	0.00	0.00	1,320.00	0.00	0.00	0.00	0.00
	(Authorized Reduction in Admin. Fee)	3.0%	($330.00)	0.00	0.00	0.00	(330.00)	0.00	0.00	0.00	0.00
	Subcontractor Total:		$11,990.00	$0.00	$0.00	$0.00	$11,990.00	$0.00	$0.00	$0.00	$0.00
	SUBTOTALS:		$77,811.20	$2,850.20	$5,720.30	$5,958.40	$13,964.45	$15,190.50	$15,131.60	$9,509.80	$9,485.95
	COMMUNICATIONS FEE:	2.40%	$1,867.47	$68.40	$137.29	$143.00	$335.15	$364.57	$363.16	$228.24	$227.66
	TOTAL ESTIMATED COST:		**$79,678.00**	**$2,918.60**	**$5,857.59**	**$6,101.40**	**$14,299.60**	**$15,555.07**	**$15,494.76**	**$9,738.04**	**$9,713.61**
	Total Estimated Discounted Cost		**($3,721.20)**	**($149.60)**	**($299.70)**	**($313.60)**	**($432.55)**	**($747.50)**	**($796.40)**	**($483.00)**	**($498.85)**